Community Assistantship Program

Westford Township GIS Demonstration Project

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Prepared in partnership with
Martin County

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Table of Contents

Executive Summary

The Community Assistantship Program (CAP) in Center for Urban and Regional Affairs (CURA) at the University of initiated the Westford Township GIS Demonstration project in June 2001 to assist the Martin County to implement GIS system in the Martin County Government. For two months (June 14, 2001 to August 7, 2001) a graduate research assistant from the University of Minnesota's Masters in Geographic Information Systems program worked with the Environmental Service Department in Martin County Courthouse on the Westford Township GIS Demonstration Project.

This report summarizes all the work the research assistant has done in this project, including the methodology, the outcomes and the needs for future work. In order to demonstrate the usefulness of GIS in the Martin County, some GIS application projects have been done and some maps that could help several county departments to improve the quality of their work have been produced. Also a presentation on August 7, 2001 to the county board and some of the staff of Martin County about the whole project was made by the research assistant. The county board has no GIS background, so this presentation and the project report also acted as a GIS education project to them.

Background and Project Goals

Martin County is located in south central Minnesota along the MN/Iowa border. Because a large part of the Martin County's Local government's inquiries involves land or geographically related issues or tasks, Martin County has started to implementation of GIS by developing GIS layers and obtaining GPS points of the county. However the existing layers in each county department are not accessible to other departments, which

is the data are stored in different format and maintained by different departments. In order to bridge this gap, this project is aimed to make the available information both internal customers and external customers; provide a comprehensive example of the usefulness of GIS using Westford Township and strengthen support for continued development of GIS within the county; identify county wide implementation needs.

GIS and its usefulness in the implementation in local government

Geographic Information System (GIS) is a system of computer software, hardware and data, and personnel to help manipulate, analyze and present information that is tied to a spatial location. It has four components: Spatial location, which is a geographical location or a certain position on the map; information, which is a display or representation of the results of analysis of the GIS data; system, which is the foundation the GIS system is running on; personnel, which is the GIS users.

GIS can be used to retrieve, store, manipulate, display and analyze geographical information. Each piece of information in the map of GIS system sits on a layer, and the users can easily turn on or off the layers according to their needs. One layer could be made up of all the counties in an area. Another could represent all the cities in the same area. Yet another could represent all the roads. The power of a GIS over paper maps is that it enables us to select the information you need to see according to what goal you are trying to achieve.

Another powerful function about GIS is it can link geographic information with other data in external database. This can be achieved by adding and linking information from other software database to the attribute table of GIS shape files. Because of the

editable flexibility of the attribute table of GIS, information brought in from other database is shown only if the user wants it to show.

Methodology

Project 1

Animal Units Analysis within Minor Watershed and Township

In this analysis, the database I am using is Minor Watershed and feedlots information within Martin County, MN. This area of 700,753 acre has a total of 78 minor watersheds and 736 of feedlots. The available data are Arcview GIS shape file for minor watershed, feedlots and township within the county as well as the Access file for feedlots indexed by an unique feedlot identification number. Each Arcview shape file has an attributes table for the statistical and text information within the shape file, which can be edited and linked by attribute tables for other shape files or text files from other software. In this project the Access file of the feedlots including the animal units information is linked to the attribute table of minor watershed shape file, so that it gives us mapping accessibility to all animal unit information carried by the environmental services department.

Steps:

1. Inside Arcview, I first use the SQL connection function to open the Access file in the Arcview table view, then summarize the table by summing up the total number of animal units of all the feedlots within each minor watershed by the summarize function. A sum table is created that contains columns of the unique identification number for minor watershed and total animal units of each of these watersheds.

2. In order to join two tables in Arcview, we need a unique value column that contains the same information in both tables. That is the reason why we need to do the summarizing first. After this, I join the summary table to the minor watershed table by the unique identification minor watershed number.
3. Then I use the calculator function to divide the total animal units of each minor watershed by the total acreage of it, and add a new field in the table with the name of "animal units per acre within minor watershed".
4. After this, in the view window, which has the minor watershed shape file appear on the screen, we want to best represent the animal units distribution within each minor watershed on the color coded map. To do this, I first use the legend editor to classify the number of animal units per acre within each minor watershed by giving different color codes to different ranges of numbers. Then I make them consistently and systematically ordered and displayed in the view by a series of gradual colored codes. Finally, I label each minor watershed by its actual number of animal units per acre, and add themes of Township and feedlots to the view. From the view, the animal unit distribution within each minor watershed can easily be seen.
5. Then I use the same method and create another map for Animal Units Analysis within each township in Martin County.

Project 2

Westford Township Drilled Wells Analysis

In this project, we want to know all the drilled wells' depth information and problem drilled wells' distribution in the Westford Township area. In order to do this, we gather

the information about the polluted status and depths of all the drilled wells in Environmental Service Department of Martin County, which are stored in Access database. So we can tie this information to GIS shape file of the drilled wells and use the spatial analysis function inside Arcview GIS to find out and display all these information on the layout map of Arcview.

Steps:

1. Inside Arcview, I first use the SQL connection function to open the Access file in the Arcview table view. Then I open the view of all the drilled wells in Westford Township and join the Access table to the attribute table of drilled wells by the unique drilled well identification number.
2. In the theme view of Arcview, I use the legend editor to give drilled wells of different depths different colors. Then I use the query to select all the positive wells and convert it into a new shape file and add it to the theme. Finally I add the minor watershed shape file to the view, and color these watersheds by different streams.

   Thus, from the view, the distribution of drilled wells in minor watershed as well as positive wells and their depth information can be easily visualized.

Project 3

Animal Feedlots within Surface Waters and Shoreland

For this project, we need to show in the layout all the feedlots within certain distance of surface waters and shoreland, which, according to the standard of environmental service department, is not currently permitted for environmental protection purposes. In order to do this analysis, a main function tool I am using is the create buffer tool in Arcview.

Steps:

First I add all types of the surface water and feedlots shape files to the view. Then I use the create buffer tool in the view tool of Arcview to create buffers within the standard distances of stream, lake and ditches respectively. Then I use the select by theme function of Arcview to select all the feedlots that are intersected with all these buffers for surface water shape files. The feedlots meet this criteria are highlighted, and I convert it into a new shape file and add it to the view.

Therefore, the buffer distribution and feedlots within these buffers are shown on the view, and after I add the attribute table of these feedlots to the layout along with the view, all the information about feedlots meet our criteria clearly displayed on the layout map.

Project 4

Westford Township Roads Distribution

For this project, we want to produce two maps showing all the roads information and parcels adjacent to a certain state highway MN15's right of way area respectively. For the first map, I add all types of roads to the view to produce the map. The second one, I use state highway MN15 and the parcels within section 10, 11, and 13,14,15 to do the analysis.

Steps:

1. For the first map, I first add the road shape file to the view, and then use the legend editor to distinguish different types of roads by giving them different symbols according to the general standard. Then I label the Minnesota state highway and

county state aid highway by their highway numbers. Finally I add the parcel, stream, city of Truman and lake shape file to the view to show the distribution of the roads in the Westford township.

2. This map is designed for the use of highway department; they want to show some detailed information about each county state aid highway. So I link all these information to the map by adding the text description information to the attribute table of each of these highways. Several parcels are highlighted, which are just adjacent to the buffer. I convert them into a single shape file and add it to the view.
3. Finally I label all the highways as I am doing in the first map and add the lake, all the parcels in Westford township, city of Truman, stream shape file to the view. In the layout, I include two maps, the big one is the zoom-in map with the parcels in section 10, 11, 13, 14, 15 as the study area, the small one is the whole parcel within Westford township as the study area. Both of the two maps contains all the themes I have done in the former steps.

Project 5

JD 47 Ditch Map

In this project, I am using the scanned ditch map of all the ditches in JD 47 ditch watershed. This project is designed for the Ditch Administration department. What they want to show on the map is the different tile sizes of these ditches.

Steps:

1. First I add the scanned map in tif format to the view using the image support extension of Arcview. Then I digitize the ditch lines according the map. The scale I

am using to digitize is 2500 meters. After I digitize all these ditches in the JD 47 watershed, I create it as a single shape file. Arcview automatically creates an attribute table of one row of polyline inside of it.

2. However, in order to distinguish different part of the ditch lines with their tile sizes, we need to split the whole ditch line into parts to add different tile size information to it. Also these ditches are distinguished from each other by their unique branch names. According to this, I use one of the digitizing tools, the split tool to split the whole ditch line into several pieces according to the branch starting and ending points on the scanned map. At the same time, I am editing the attribute table of the ditches by adding branch name and tile size of each split ditch. So two new columns are created in the table, one is the branch name, and the other is tile size.
3. After this, I use the legend editor function of Arcview to color the ditches by their tile sizes, and label them by their branch names.
4. In the layout, I add this view to the map. I add another small map of ditch watershed of Westford Township with JD 47 ditch watershed highlighted and labeled. Also a table of some benefits, location and area information about this watershed is included.
5. There is a problem I encountered when I am doing this project. This scanned ditch map wouldn't overlay with our existing ditch watershed shape file created in Arcview because of the different projections they are using. This can't be overcomed by Arcview, we need to use another certain kind of software to convert it. So this is the reason why I add a small map of the JD 47 ditch watershed to the layout instead of overlay it to the digitized ditch shape file. This hurdle has prevented us from doing further spatial analysis with the ditches.

Project 6

Parcel within Certain Distance of Feedlots

This project is designed according to the needs of Environmental Service Department. We want to know all the parcels with their detailed information that are within a certain distance of a certain feedlot. In order to achieve this, I am using the buffer function in Arcview to do this analysis.

Steps:

1. In this project, I use the parcel shape file within section 10, 11, 13, 14, 15 as the study area. I add this shape file as well as the feedlots shape file of Westford Township to the view. Then I choose a feedlot that is relatively in the center of the study area. I highlight the feedlot and convert it into a new shape file and add it to the theme.
2. After this, I create a buffer of 1 mile in diameter around this feedlot point. In order to find out the parcels within 0.25 miles of the feedlot, I use the select by theme function to select all the parcels that are intersected with the buffer circle. Then I convert these selected parcels into one shape file and label them with their unique identification number.
3. In the layout, in order to show more detailed information about these parcels, I also add the attribute table of the parcel shape file to the map, which contains information about the address, the owner, and pin numbers of the parcels.

Project 7

Parcel land value and building value

In this project, we want to have a simplified representation of land value and building value of parcels in Westford Township for the needs of Assessor's department.

Steps:

1. I first add the parcel layer within section 10, 11, 13, 14, 15 to the view. Digitizing the Autocad parcel polyline shape file imported from Autocad at the scale of 2500 meters creates this shape file. It's now a shape file of polygons, each of which represents a certain parcel. In the attribute table of the parcel shape file, I add two columns of parcel identification number (PIN) with the name of Pin number1 and Pin number2. One for PIN with delimiters between the numbers (20.123.3544), the other one for PIN without delimiters (201233544). The purpose for adding these two types of pin number in the table is to link parcel information from two text files in Access database, which have two different types of PIN entries.
2. In Arcview, I import the Access file that has PIN without delimiters, which contains information about parcel land value and building value by the SQL connection function, and join the two tables to the parcel shape file's attribute table by the PIN. So the land value and building value of the parcels are now available in Arcview to do further analysis. Then I label all the parcels by using two different colors for land value and building value. From the view, we can easily see the information of each parcel.

Since I haven't done all the digitizing work for the entire Westford Township, I can't do more comprehensive spatial analysis according to the department's need. In

order to show the possible applications, I have created another map of parcels within the JD 47 ditch watershed using the polyline shape file of parcels for the whole township imported from Auto cad. Then I overlay the JD 47 ditch watershed on the parcel layer, and use the select by theme function to select all the parcel polylines that are intersected with the JD 47 ditch watershed. If I have finished all the digitizing, I can then use the polygon shape file of all these parcels to do more comprehensive spatial analysis with other land use shape files.

I also use the same method to create another map of Westford Township COGO map, showing all the COGO points inside the digitized parcel layer area and label them with their unique GPS point number on the map, and add an attribute table of the COGO shape file, which contains Tie information about each point imported from Access database.

Needs Assessment

In order to further develop GIS system in Martin County, and improve the quality of government services and decision-making, several tasks need to be done to ensure the successful implementation of GIS.

- GIS tools

1. Software Purchasing needs:

Currently in Martin County, we already have a desktop mapping GIS software Arcview GIS Verson 3.2, which contains almost all the major functionality of GIS. Yet some of the powerful components of Arcview are not accompanied with this software. For example, Arcview Extensions spatial analysis, which provides more sophisticated spatial analysis functions. Also the network extension, which will enable us to calculate

distances, the most efficient routes and to summarize network flow rates in relation to other data will also be very helpful in highway department.

When we scanned the ditch maps in ditch administration department, we need to buy a certain kind of software to overlap the imported digital map from the scanned map with the existing shape files created by Arcview GIS.

In the highway department, we have computer-assisted design (CAD) software to draw parcel maps based on the GPS points of section corners and plat maps and parcel legal descriptions. We also have the global positioning systems to collect GPS points in the highway department and Environmental Service Department, and have created COGO maps. But all these maps have different coordinate systems from the other land use shape files created by Arcview (i.e. roads). We used the projection wizard extension in Arcview to adjust them, but there still existed a difference of about 0.5 mile. A more efficient software is needed to convert the coordinate system more accurately.

2.Software and hardware upgrades

Like all the other computer systems, GIS is also running on a basis of a series of hardware and software. All these have to be updated periodically according to the computer system's internal needs to match with all the other software which will be used in sharing data with GIS software.

In order to transfer and share data between different departments, we will need a larger computer network server with large storage spaces to process these data.

- Personnel

The successfulness of the implementation of the GIS system also largely depends on the skill of the users. To ensure the GIS users in Martin County possess the adequate

skills and knowledge to make use of GIS system, we need to have an organized team who work together on a coorporative basis.

1. Expertise for on-site technical support to develop and use GIS system

Since Martin County now doesn't have any GIS specialists on staff, we will need to hire GIS experts on site to provide long term technical support as the implementation is going on. The experts will also perform as a team leader in GIS implementation process. Also the experts will be responsible for educating all the other county staff on GIS software usage.

2. Educate all the staff who will use GIS

Some separated departments manage the GIS system implemented in Martin County, and responsibilities are shared by more than one department. Different departments may have different needs for GIS, so in order to run the GIS system in these groups, every department which is participating in GIS implemetation should have at least one staff member who has necessary knowledge and ability to make use of the GIS in his or her own department. The staff will need to understand the theory of the system and how it works. He also needs to be able to use GIS to identify and manage everyday services needs and maintain the GIS database inside his department. Moreover, he or she should acquire the ability to do advanced analysis according to the specific need of the department.

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